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Development of a cost-efficient method for micro-scale heat transfer and temperature studies

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Thermo-chromatic liquid crystals (TLCs) are chiral molecules that reflect specific wavelengths of visible light. The wavelength reflected is proportional to the temperature of the TLCs. Electroporation used as an active enhancement for transdermal drug delivery produces micro scale thermal patterns around local transport regions (LTRs) on the skin surface. A previous study conducted used thermo-chromatic liquid crystals to produce isotherms around the LTRs. Another method involving TLCs are also used to map convection coefficients on surfaces exposed to fluid flow. The goal of this study was to develop experimental methods involving TLCs to be used on the micro scale at low financial cost. A microscope was built utilising a cell phone camera and a lens from a laser pointer to provide magnification shown to be 100x-200x. The capabilities of TLC was conducted at the University of Canterbury by collecting image data of TLC coated surfaces with a cellphone and then post processing the images in MATLAB to produce temperature maps based on collected colour data. Studies conducted show thermal gradients $>10^4$ Km^{-1} can be captured and that the entire colour range could be utilised for studying electroporation. Future research developments use the method to study microfluidics along with existing applications. Beyond research studies, it is also applicable as an educational tool due to its accessibility and the low financial capital required.